Different uniform asymptotic techniques exist for the construction of these canonical problems. Although some of them are referenced, it would have been very informative if the editor could have included the papers by Ahluwalia, et al (SIAM J. Appl. Math., 1968) on the Uniform Theory of Diffraction and those by Rahmat-Samii and Mittra (Radio Science, 1978) and Boersma and Rahmat-Samii (Radio Science, 1980) on the comparison of many existing uniform asymptotic diffraction theories. Also from the content of this section one observes that there are still some important canonical problems for which "good" engineering asymptotic solutions have not been found. As an example, one may refer to the caustics, corner diffractions, edges and wedges illuminated by non-ray fields, etc. A considerable amount of work is being pursued to devise simple uniform asymptotic solutions for these problems. It is hoped that in the next few years, these results will be available as tools for the antenna engineer who will be able to use them for solving ever-increasingly difficult scattering problems.

Part III (Applications, 154 pages) is the fruit of the previous parts, in which all the canonical solutions developed before are used to solve the following engineering problem categories: horns and guides, apertures and arrays, reflectors, aircraft and satellites, and miscellaneous. For each category, key papers and useful lists of references are provided. Part III starts with the classical paper by Kinber on sectoral horns and includes the works of Ryan, Rudduck, Peters, Burnside, Jull, Mentzer and many others. Many pages of this section are devoted to the calculation of the radiation fields generated by horns; an observant reader can notice how the use of both the higher order diffractions and slope diffractions can improve the solution for wider observation angles. Also the results of this section clearly demonstrate that GTD is capable of providing field descriptions even in the near fields when intersecting edge rays from different specular points are considered. This is very important for many applications in which different sections of the scattering objects are not necessarily in each other's far-fields. This part ends with some papers addressing the difficult problem of determining patterns of antennas in the vicinity of complex scattering objects such as airplanes.

Part IV (GTD and Moment Method, 16 pages) consists of two papers on the topic of integrating the GTD solution with the Moment Method approach. This integration is an interesting topic, as future works will be expected to address more complex problems where each method by itself will not be able to handle the problem. The first paper by Theile and Newhouse considers the Moment Method solution of an antenna in the vicinity of edges and wedges. The GTD construction is used to effectively and efficiently augment the edge diffraction effect into the matrix solution of the Moment Method. The second paper by Burnside et al, also addresses a similar problem concerned with both the straight edges and curved surfaces and demonstrates how the Moment Method can be used to extend the domain of GTD for those geometries where a "good" solution for canonical geometries does not exist. Since both papers are dated 1975, one wonders why the editor did not include papers after 1975. Also, the references cited in this part are rather unrelated to the topic of interest and some recent works by researchers from the University of Illinois on the topic of hybrid methods are not referenced.

All in all, this is a very useful volume for electromagnetic researchers and engineers. In spite of the fact that all the included papers had already been published in the open literature, their collection in one volume not only saves a considerable amount of searching time when they are needed but also gives a flavor of how the GTD concepts have matured and what future problems should be solved. Perhaps the volume would have been even more useful for the antenna engineering community if an accompanying handbook of the key GTD formulas had been assembled and presented with unified notations in their domain of applicabilities.

Reviewed by: Dr. Y. Rahmat-Samii
Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California 91109

Nonlinear Electromagnetics, edited by P. L. E. Uslenghi, Academic Press, New York, 1980, Price $30.

The theory of nonlinear electric circuits is a highly advanced subject. It has been intensively developed in the Soviet Union under the direction of N. M. Kryloff and N. N. Bogoljubov for the past fifty years and has been an active topic of research in western countries for about thirty-five. On the other hand, research on nonlinear electromagnetic waves is just getting under way and has only recently started to receive the serious attention it deserves. Of course, much of this attention is due to the expectation that nonlinear electromagnetic wave phenomena will find use in radically new devices and radically new systems.

As is well known, nonlinearity in electromagnetic wave phenomena does not come from the Maxwell equations but from the equation of motion which is inherently nonlinear. Usually, the nonlinearity is negligibly weak and the familiar linear electromagnetic theory applies. However, in a growing number of practical cases, the nonlinearity is far from negligible and the attendant phenomena resist conventional methods of analysis because in such cases the principle of superposition does not hold, Fourier techniques can not be used, and the electromagnetic field can not be scalarized.

A classic example of nonlinear wave phenomena is the "Luxemburg effect", a cross-modulation effect produced by the nonlinear interaction of radio beams intersecting in the ionosphere. To explain this effect, clever ad hoc methods were used with the physics of the problem always guiding the mathematical analysis. Now, however, the trend in nonlinear wave research is less physical; it follows methods (mostly computational) that have been used to study solitary waves and solitons in fluid dynamics.

What seems to be needed for the advancement of nonlinear electromagnetics is knowledge of the basic laws of nonlinear electromagnetic wave phenomena. Years ago, J. W. Goethe remarked in his Geschichte der Farbenlehre: "In science all depends on what is called an apercu, on a recognition of what is at the bottom of the phenomena. And such a recognition is infinitely fruitful." More recently, J. R. Pierce in his Almost All About Waves made a similar observation of the fruitfulness of insight, i.e. apprehension of the inner nature of the phenomena. Hopefully, future work will help us find out "what is at the bottom of the phenomena" and will give us "insight" into their inner workings. Perhaps F. Zwicky's morphological approach would lead most systematically to what is needed.

As a most recent contribution to nonlinear electromagnetics the present book is worthy of note. It is a collection of thirteen subjectively selected papers on nonlinear electromagnetic phenomena, eight of which are modified versions of talks presented before the IEEE/URSI International Symposium at the University of Washington in June 1979, and five of which are papers written specifically for this book. The collection was expertly edited by P. L. E. Uslenghi and was given an international flavor by papers from Italy (G. Franceschetti and I. Pinto), from West Germany (F. Kaiser), and from the U.S.S.R. (A. B. Shvartsburg).

The first paper, by P. L. E. Uslenghi, is a compact review of the mathematical techniques that have been found useful for dealing with nonlinear problems. It gives a convenient glossary of nonlinear differential equations for physicists and engineers. It provides a pleasant introduction to what Sommerfeld would have called the "physical mathematics" of the subject.

The second paper, by A. C. Scott, is a short history of solitary waves and solitons. It is thorough, authoratative, beautifully written, and truly a pleasure to read.

The third paper, by D. W. McLaughlin, is methodological. It introduces the reader to the "inverse spectral transform" by showing how this transform method can be used to analyze the nonlinear interaction of a laser pulse with a two-level medium. One of the notable features of the paper is its emphasis on the physics of the nonlinear mechanism. The reader will find the references at the end of the paper useful for acquiring a fuller understanding of the method.

The fourth paper, by I. M. Besieris, is a research report concerning electromagnetic wave propagation in a medium that is not only nonlinear and dispersive but also subject to statistical fluctuations. The paper describes a method for taking into account such fluctuations and applies the method to the problem of how a single soliton evolves in the presence of fluctuations.

In the fifth paper, by N. Marcuvitz, the novel "quasiparticle" method is applied to the nonlinear propagation of a scalar wave having fast and slow parts. The method prescribes an averaging out of the fast part and gives an interesting description of the resulting wave in terms of quasiparticles.

The next two papers, by A. B. Shvartsburg, entitled, "The Nonstationary Evolution of Localized Wave Fields in Nonlinear Dispersive Media" and "The Nonlinear Resonant-Wave Interaction in a Collisional Magnetoplasma," are the two longest papers of the book. Unfortunately, however, these papers are rather difficult to understand (at least this reviewer found them to be so), and the reader may have to work a little to extract and decipher the interesting information they contain.

The eighth paper, by F. W. Crawford, is a brief essay on the application of Lagrangian methods to the interaction of electromagnetic fields and plasma. It notes the work that has been done at Stanford on this subject and comments on future developments.

The ninth paper, by G. C. Papanicolaou, describes a formal procedure for obtaining macroscopic constitutive relations from microscopic laws. It places emphasis on the averaging process and uses a "multiscaling" argument which the reader may wish to examine further.

In the tenth paper, by A. G. Ramm, a one-loop network consisting of a time-dependent voltage in series with a linear element and a nonlinear element is studied. Questions regarding existence, uniqueness, and stability of stationary regimes are discussed, and several pertinent theorems are proved. The tone, style, and language of the paper is mathematical and may be more conductive to network control theorists than to those working in electromagnetics.

The eleventh paper, by G. Franceschetti and I. Pinto, should be of great interest to antenna engineers. It discusses the problem of a nonlinear load connected to an antenna. A nonlinear model of the load is reduced to solving a Volterra nonlinear integral equation. A review of the Volterra series solution is given, and convergence properties as well as truncation errors are discussed. Computational examples are worked out.

The twelfth paper, by F. Kaiser, is a very readable essay on nonlinear oscillations in physical and biological systems. It discusses limit cycle oscillations, Van der Pol's equation, neurons and nervous systems, rhythmic activities in the brain, limit cycle model for bain waves, and other attractive topics. It is an excellent review of the nonlinear phenomena that can occur at the border between physics and biology.

The last paper, by F. S. Barnes and C. J. Hu, examines the effect of electromagnetic waves on biological materials and processes. In particular, it discusses the possibility of rectification in membranes, the influence of electric fields on the orientation of long chain molecules, and the influence of short pulses of high intensity. The mechanism of the interactions is presented to the reader clearly and interestingly.

Clearly, the scope of the book is very broad. It covers topics in: the history of science (Scott), antenna engineering (Franceschetti and Pinto), plasma physics (Shvartsburg; Crawford), network theory (Ramm), physical biology (Kaiser; Barnes and Hu), physical mathematics (Uslenghi; McLaughlin), and wave propagation (Besieris; Marcuvitz; Papanicolaou). So in going through this book the reader will probably be eased into areas that lie ouside, or next to, his specialty. But this is a point of merit because generally workers in electromagnetics are, or like to be, universalists.

The editor and the authors deserve praise for their valuable contributions. Their selfless efforts will undoubtedly help advance this very interesting field of research.

Reviewed by: Professor C. H. Papas
California Institute of Technology
Pasadena, CA 91125

Antennas In Matter, by R. W. P. King and G.S. Smith, Cambridge, Mass.: The MIT Press, 1981, XVI + 868 pp., Price $75.00.

This is a volume of scope and size reminiscent of King's well-known 1956 book on Linear Antenna Theory. It contains almost 900 pages, nearly 400 numbered figures (and probably at least 2,000 separate graphs) and in 13 chapters covers topics ranging from basic EM theory, to medium constitutive parameters, to experimental techniques.

The book's organization is somewhat unusual. Part I, which is "introductory, elementary and fundamental," contains four chapters and 305 pages which by page count are devoted primarily to insulated antennas, the topic of the first chapter. Chapters 2, 3 and 4 deal with bare antennas, linear antennas used as probes, and waves and antennas in a dissipative half space. Part II consists of 7 chapters in over 400 pages, and provides a more advanced treatment of EM theory and antennas. Topics covered here include EM theory and constitutive relations (Chapters 5 and 6), bare and insulated linear antennas (Chapters 7 and 8), circular loop antennas (Chapters 9 and 10), and antennas near a planar interface (Chapter 11). Part III discusses the construction of experimental models and the techniques of antenna and probe measurements in general dielectric or dissipative media, in two chapters of about 100 pages. The basic thrust of the book is twofold: 1) to understand the effects